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The Distribution of Norway Pout in the North Sea and Adjacent Waters

By D. F. S. RAITT and JAMES MASON
Marine Laboratory, Aberdeen
May 1968

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By D. F. S. Raitt and James Mason

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CONTENTS

	Page
Introduction	3
Overall Geographical Distribution of Norway Pout	3
Trawling Surveys, 1930–53	4
The International Herring Surveys, 1960–61	12
Distribution, Hydrography and Depth, 1960–61	14
The Fladen Survey, 1961	17
Discussion	18
Summary	18
References	19

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The Distribution of Norway Pout in the North Sea and Adjacent Waters

INTRODUCTION

The geographical distribution of Norway pout [*Trisopterus esmarkii* (Nilsson, 1855)] was first described by Schmidt (1909) from the occurrence of the larvae during plankton surveys of the north-east Atlantic from Iceland and Norway in the north to the Bay of Biscay in the south. Schmidt recorded the larvae from the west and south-west coasts of Iceland, at Faroe, in the northern North Sea, Skagerrak and Kattegat, off the west coasts of Scotland and Ireland and in the Irish Sea. No fully comprehensive information is available on the distribution of the adult fish although there are numerous references scattered throughout the literature (see section on overall geographical distribution). In the North Sea the Norway pout is both a valuable item in the diet of several commercially important food fish species (whiting, cod, megrim, etc.) and also a potential industrial species for reduction to fish meals and fertilisers. A programme of research was, therefore, initiated in 1960 at the Marine Laboratory to investigate its life history and biology. Papers have already appeared in this series on the delimitation of the stocks (Raitt, 1965) and on the food and feeding of Norway pout (Raitt and Adams, 1965).

This paper contains information on the abundance and distribution of Norway pout in Scottish waters from early research vessel trawling records of the Marine Laboratory, Aberdeen. Material on catching rates is also presented from conjoint herring trawling surveys undertaken in the North Sea by Scotland, England, Denmark, Germany and the Netherlands in 1960 and 1961. The overall geographical distribution of the adult fish is reviewed, and recent information from trawling surveys at the northern and southern limits of its range is included.

The authors thank Mr K. Popp-Madsen of the Danish Fisheries Laboratory at Charlottenlund, Dr K. Schubert of the Institute for Sea-Fisheries, Hamburg, and Mr J. C. Corlett of the Fisheries Laboratory Lowestoft, who supplied the data from international herring surveys by "Dana", "Anton Dohrn" and "Ernest Holt" respectively.

OVERALL GEOGRAPHICAL DISTRIBUTION OF NORWAY POUT

The Norway pout occurs only on the continental shelf on the eastern side of the North Atlantic and its range of distribution is shown in Figure 1. It is generally most abundant in waters 100–200 metres in depth. It is very common off the west and north Scottish coasts and in the northern North Sea. It is also found in some numbers in the Skagerrak and Kattegat and the southern Baltic (Petersen and Levinsen, 1900; Ehrenbaum, 1936; Hannerz, 1961). It has been recorded from the Norwegian fjords as far north as Lofoten and also from Bear Island and the western part of the Barents Sea. Svetovidov (1948) relates these northern records to the recent general warming up along the shores of the Scandinavian peninsula, and Baranenkova (1960) associates the large numbers of Norway pout in the southern Barents Sea in 1959 with the high intensity of the Murmansk Current in that year and the above-normal water temperatures from March onwards. Maslov (1944) found spawning individuals in great numbers at the Lofotens and the young at Bear Island, and Boldovsky (1939) identified several specimens from the Barents Sea.

More recent trawling records of the English research ship "Ernest Holt", kindly supplied by Mr R. Blacker, gave the following results:—

"Norway pout were caught in quite large numbers in the cod-end cover on the Malangen Bank and Sven's Ground off the north-west Norwegian coast. Catches of $\frac{1}{2}$–$1\frac{1}{2}$ baskets per haul were recorded including many mature, ripe females."

The Norway pout is abundant at Faroe and Faroe Bank and on the north-west, west and south coasts of Iceland (Saemundsson, 1949: Kotthaus and Kreft, 1957), although Saemundsson states that it is not found on the colder north and east coasts.

At the southern end of its range its distribution extends into the Irish Sea (Gokhale, 1953) and one specimen has been recorded from the extreme western end of the English Channel (Garstang, 1900–03). Blacker (1962) in a recent report on rare fishes recorded in catches by exploratory fishing vessels from fishing grounds to the west of the British Isles found Norway pout on the Farm and Porcupine Bank grounds off the

Fig. 1. Overall geographical distribution of Norway pout.

west coast of Ireland. Other records of Norway pout from this area have been reported by Holt and Calderwood (1895). Unpublished trawling records of the Marine Laboratory, Aberdeen, from other oceanic banks, Rockall, Bill Bailey, George Bligh, etc. off the west coast of Scotland, however, show no instance of this species being caught, but it is interesting to note that the closely related and generally more inshore species *T. minutus* (poor cod) was recorded on several occasions from Rockall Bank. Schmidt (1909) also noted the presence of the larvae of *T. minutus* at Rockall but not those of the Norway pout.

TRAWLING SURVEYS, 1930–53

The distribution of Norway pout in the North Sea and adjacent waters was first studied by analysing the trawl-catch records of F.R.S. "Explorer" in the years 1930–37 and 1946–51. The records for corresponding

months in the various years were combined. Because of the limited sampling in these months, samples taken in January—February and November—December were treated together. Not all the regions were covered in all months, and though the records were supplemented where possible by those of a few hauls made by "Explorer" in 1952–53 and F.R.S. "Scotia" in 1949–53, complete coverage was still not obtained. Sampling was adequate in almost all regions from April to September, and in the northern North Sea at almost all times of the year. The area covered was limited to some extent by the depths at which trawling was possible, no hauls being obtained, for example, in the Norwegian Deeps.

Until June 1949 "Explorer" used an otter trawl with a 58 ft groundrope; from then until December 1952 46 ft and 48 ft "Aberdeen" trawls were used, and in January 1953 a 30 ft trawl was introduced. "Scotia" chiefly used a 30 ft otter trawl. Fine mesh cod-end covers were used on all occasions. Any differences between catching powers of nets and ships were ignored, since no suitable comparative data are available. Relatively few hauls with the 30 ft trawl are used in the present study, and almost all those included were made off the west coast of Scotland and at the Faroes. The figures quoted in the text are the average numbers caught per one hour's trawl haul, and Figure 2 shows the total numbers of hours' fishing each month in each statistical rectangle. No data are available on cod-end mesh selection for either the "Explorer" or "Scotia" surveys but it is considered fish 1-year-old and over ($\geqslant$ 10 cm) were above the selection range while there may have been selection of younger fish (mainly $<$ 10 cm).

From the time (May–June) when a new brood appears in the trawl catches as O-group, until the following May, when it is some 14–16 months old, it is possible to distinguish it from older fish by examining the length-frequency distribution of the catches. For convenience, in this paper the O-group fish will be called "juveniles" and older fish "adults". The separation is difficult after May owing to overlapping of length-frequencies. As a typical example the catch taken in statistical rectangle XX15 on 10th August 1930 may be given:—

Cm	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
No.	—	16	51	65	30	—	—	—	—	—	12	23	33	56	48	39	16	1	—

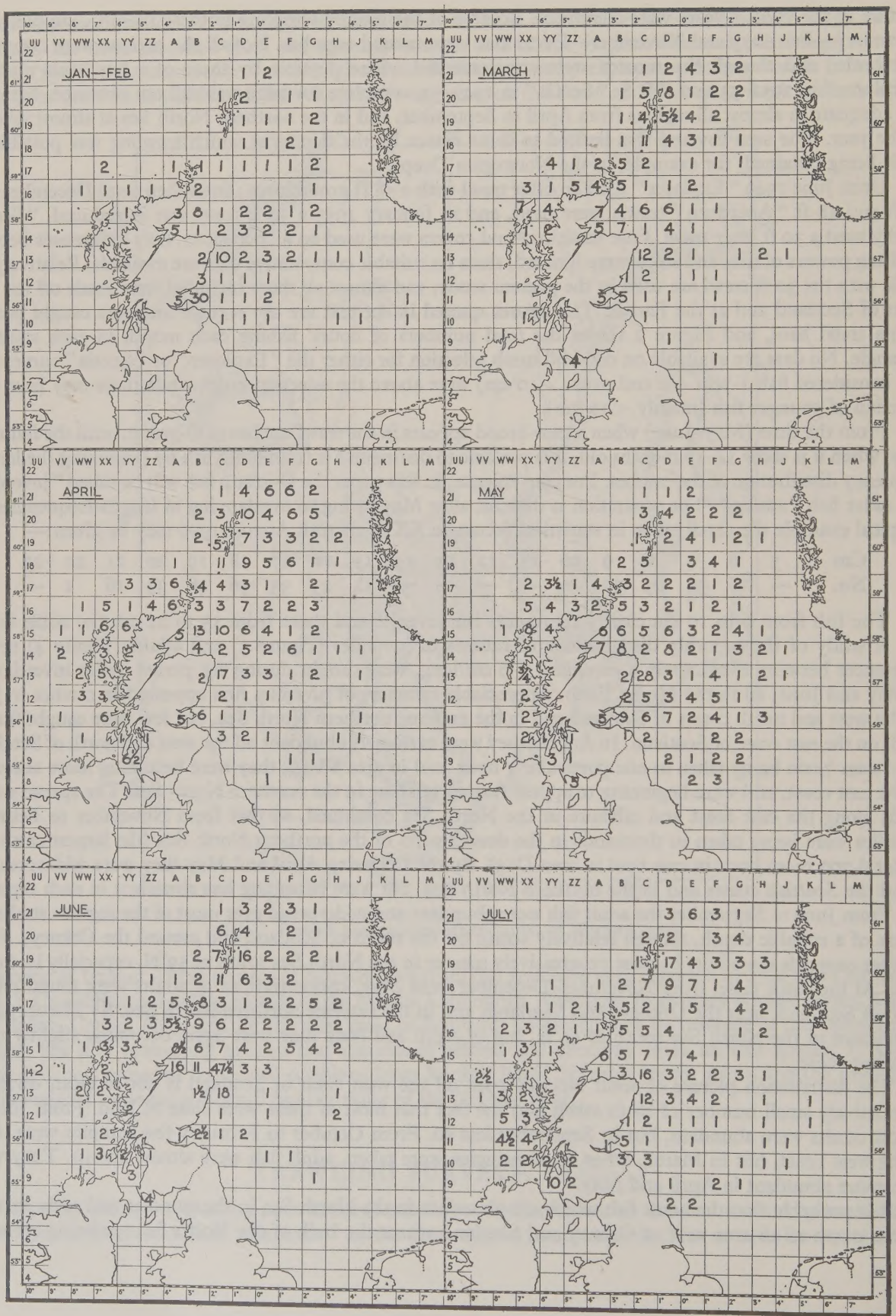
The fish from 6 to 10 cm clearly represents the juvenile and those from 15 to 22 cm the adult fish.

A study of the monthly distributions of catches of juveniles (Figure 3) and adults (Figure 4) reveals differences between them. Only 9 juveniles, 2–6 cm long, were caught during the period under investigation in May and June, all in the Moray Firth. Appreciable numbers of juveniles first appeared in catches in July, off the west and north coasts of Scotland and in the extreme northern North Sea, but few were caught further south on the east coast of Scotland. In August they were extremely abundant off the west and north of Scotland, more than 7,000 being taken in one particular 1 hour haul in area VV15; they were becoming more abundant on the east coast, and were beginning to appear further offshore in the northern North Sea. The spread southwards along the east coast and offshore in the North Sea continued, so that from November to February juveniles were being taken in thousands in the deeper parts of the northern North Sea (the largest catch was almost 6,700 in an hour in one haul in area D15). By the following April and May they were widespread all round the Scottish coasts and in the northern North Sea, but were becoming less abundant in each region.

From June to September the adult fish were abundant and widespread over most of the regions studied in waters of a suitable depth, though relatively scarce off the north of Scotland and around the Orkneys. From October onwards the adults became progressively scarcer in the North Sea south of 59°N, especially in coastal areas. At the same time, from November–December until May, concentrations of adults were found off the north of Scotland, near the Orkneys and Shetlands and in the extreme northern North Sea. By March, adults were scarce in the North Sea south of 59°N, but in April and May they were again becoming slightly more abundant there.

The distribution picture of adult Norway pout off the west coast of Scotland is not so clear, owing to the relatively small number of hauls taken and the fact that most of these were close to land. From June to August adults were abundant, but in September less so. From October to February few samples were taken on the west coast, but in March, when more samples were taken, adult fish were almost absent. They were again more abundant in April and May.

It is probable that the adult fish which are abundant in the North Sea in the summer and early autumn migrate north to an area west of Orkney and Shetland where the bulk of the North Sea spawning seems to


JAN—FEB
MARCH
APRIL
MAY
JUNE
JULY
UU VV WW XX YY ZZ A B C D E F G H J K L M

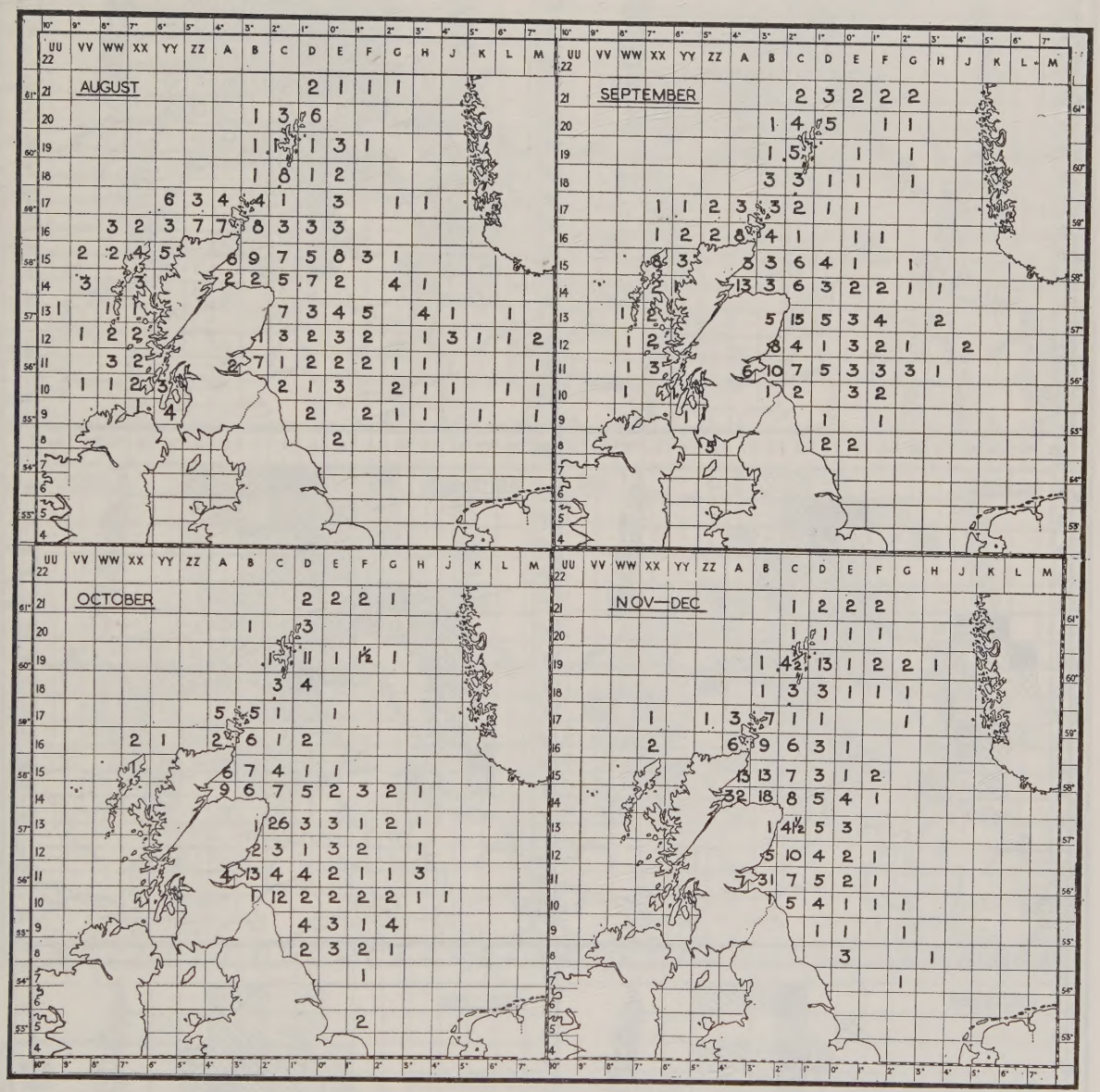
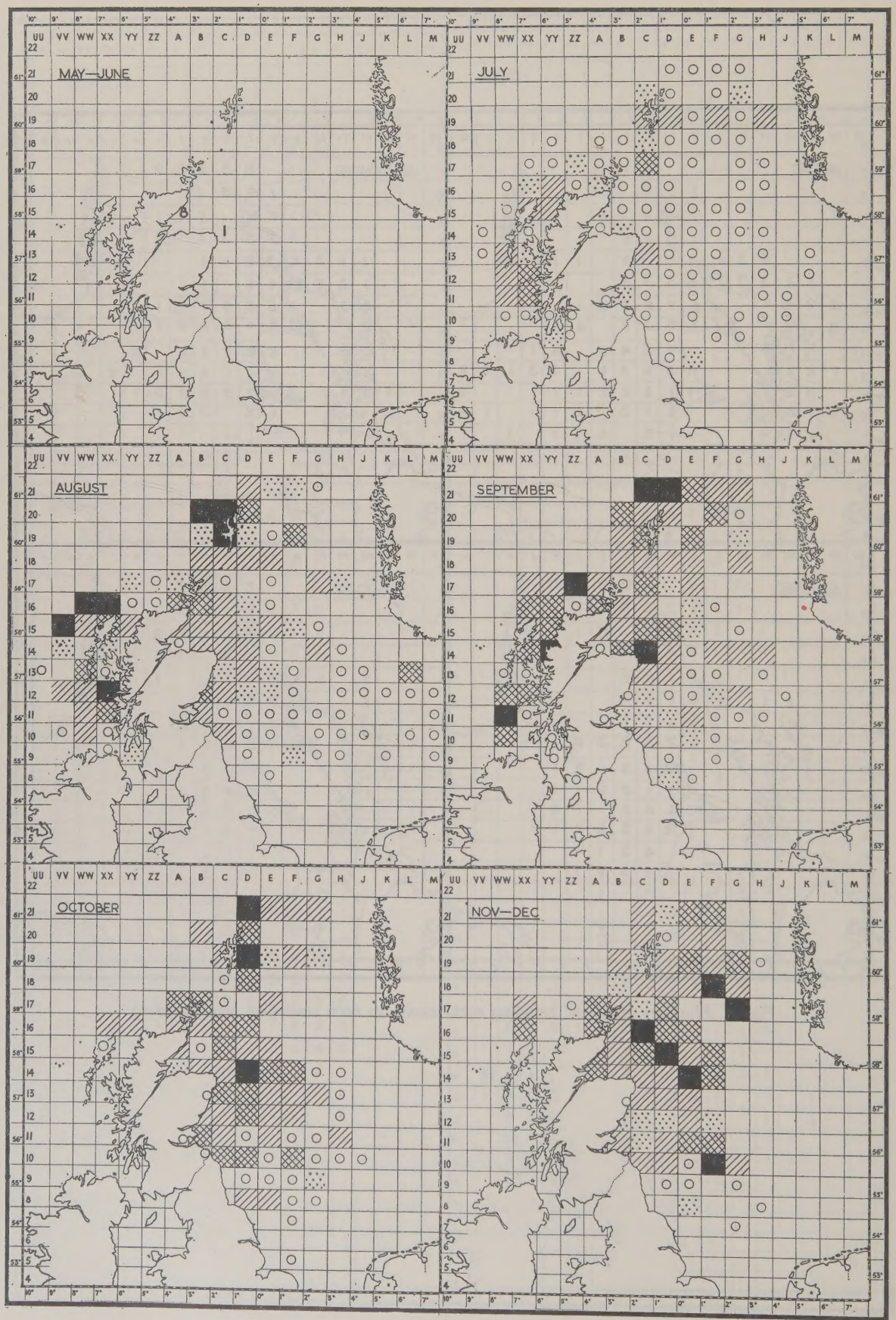
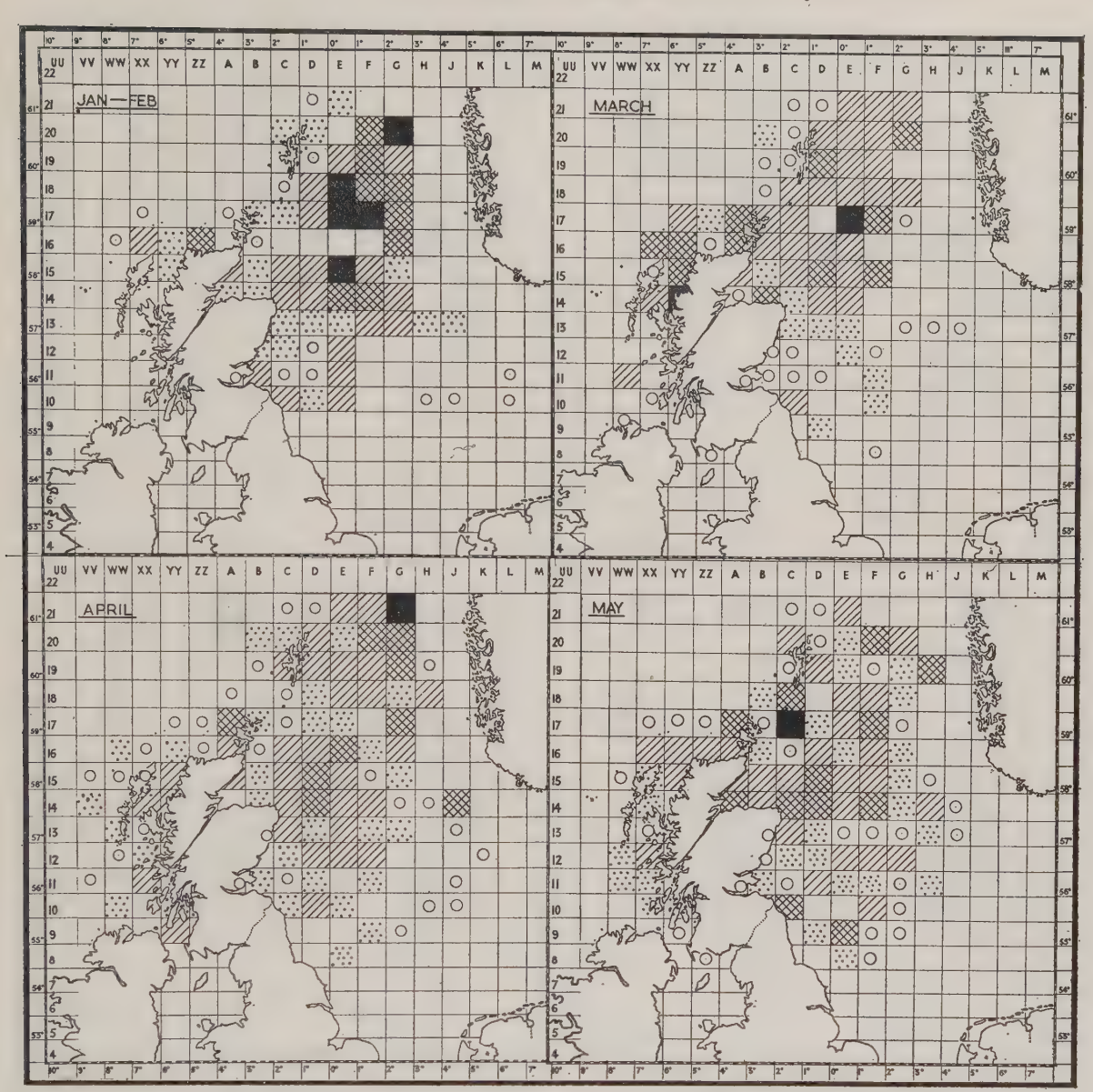


Fig. 2. Number of hours' trawling each month in each statistical area, 1930–53.


MAY—JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOV—DEC



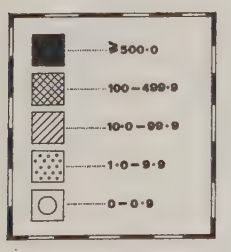
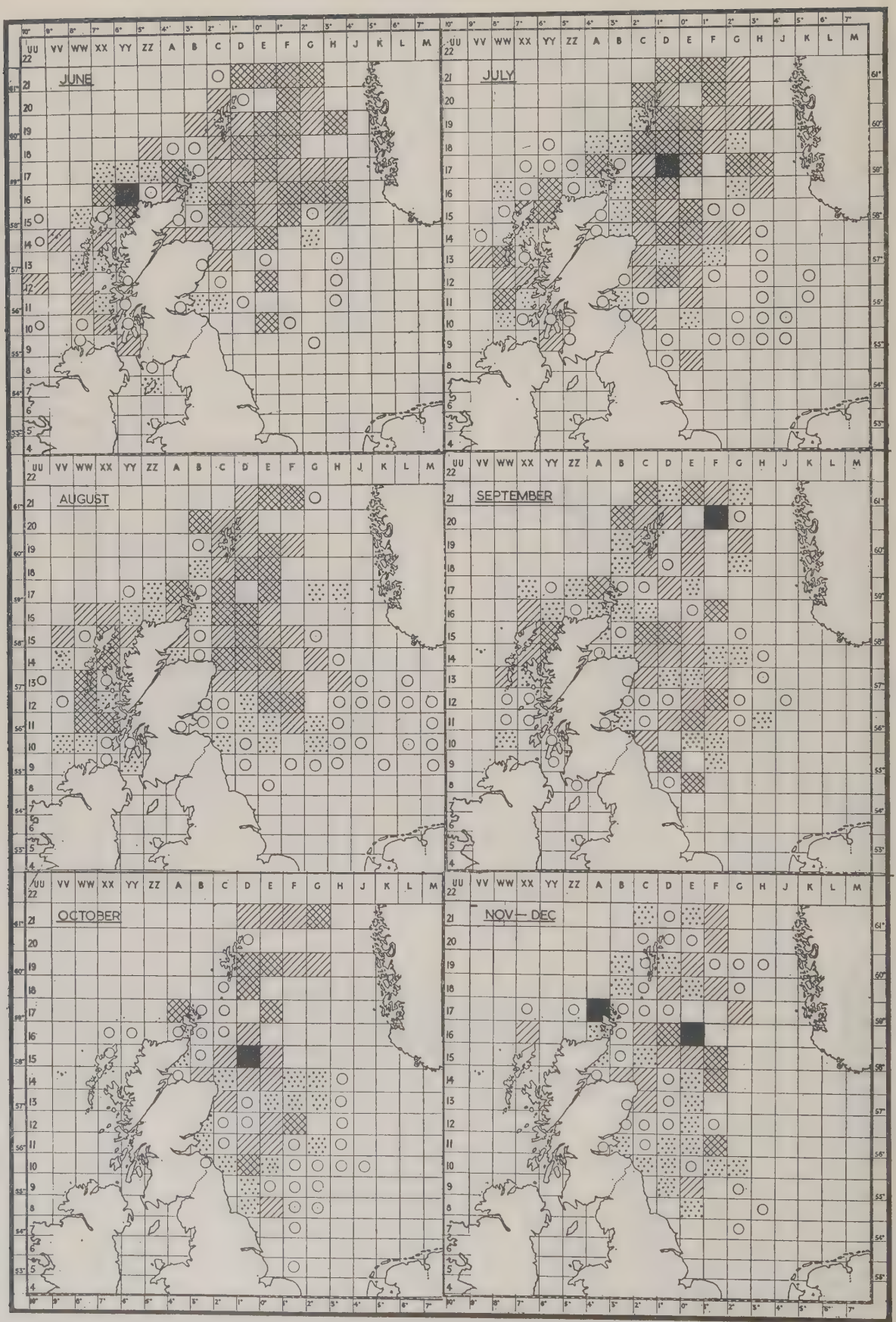


Fig. 3. Monthly distribution of juvenile Norway pout, as shown by trawl catches 1930–53, for one year after the first appearance in catches.
May–June.—Actual numbers caught. Areas fished in which no specimens were caught can be seen by reference to Figure 1.
July–May.—Numbers caught per hour's fishing shown diagrammatically as in the key.


JUNE
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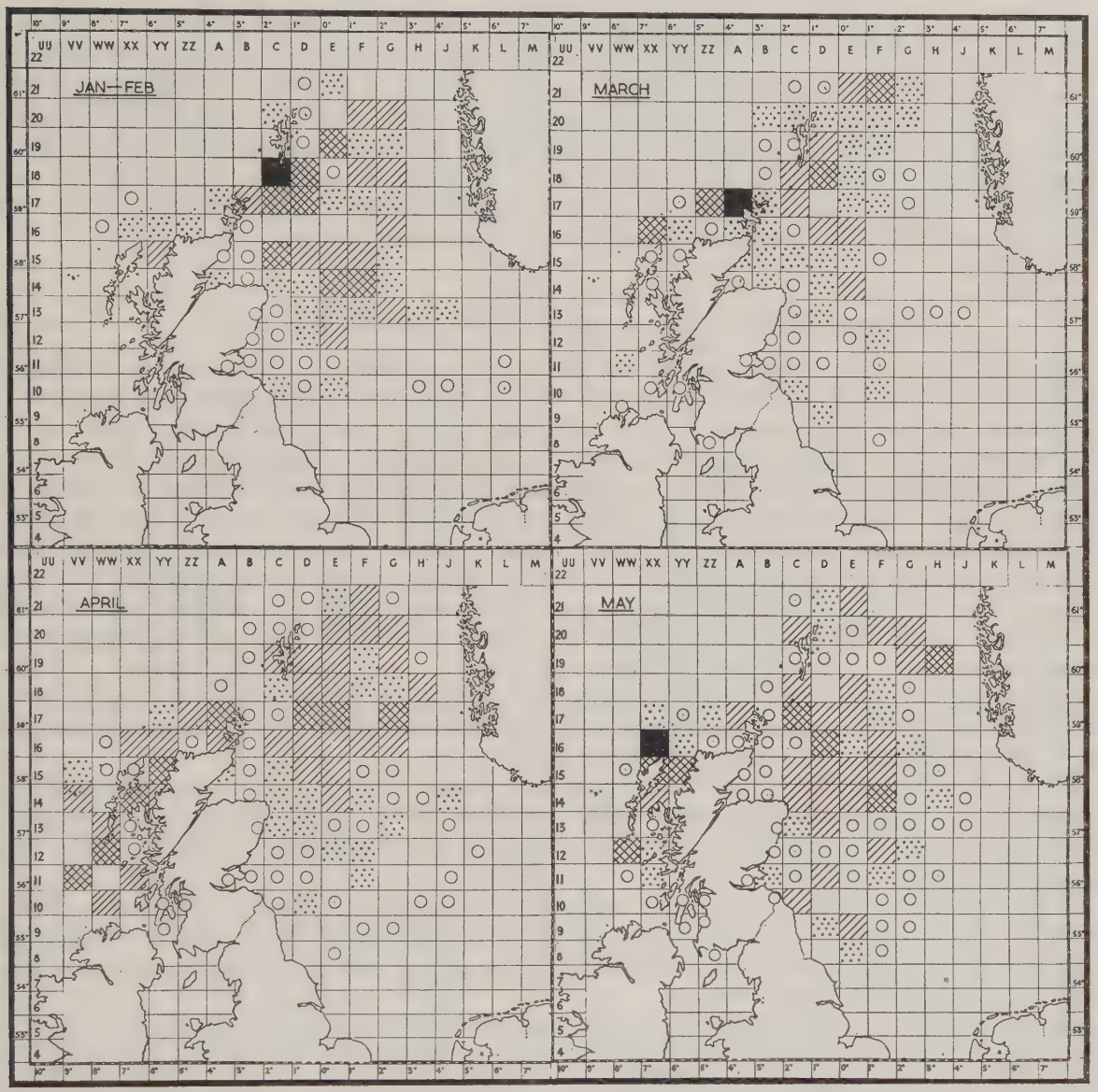
NOV — DEC
UU VV WW XX YY ZZ A B C D E F G H J K L M



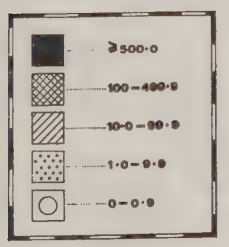


Fig. 4. Monthly distribution of adult Norway pout as shown by trawl catches 1930–53. Numbers caught per hour's fishing shown diagrammatically as in key.

take place in the late winter or early spring. Spawnings also occur off the Scottish north coast and the Butt of Lewis but there is no evidence of any mixing between these populations and that in the North Sea (Raitt, 1965).

The poor coverage of the west coast sampling makes it difficult to determine the pattern of distribution there, but the nature of the currents and the fact that adults were almost absent there in March suggest that little spawning occurs in coastal waters to the west of Scotland and that the population there is derived from spawning in the late winter or early spring offshore to the south-west of Scotland or to the north of Ireland. The larvae then probably drift back to the west coast of Scotland. Gokhale (1953) suggested that a spawning in this area maintains the Irish sea population of Norway pout in the same way.

THE INTERNATIONAL HERRING SURVEYS, 1960–61

Although data are not available from all the ships which participated in the international young herring cruises in the spring and autumn of 1960 and 1961 a fair coverage of the North Sea was obtained from most of the surveys. The trawl hauls were all of 1 hour's duration. No data on the cod-end mesh selection of Norway pout on these surveys were collected but it is reasonable to assume that the fish 1-year-old and over ($\geqslant$10 cm) were above the selection range while there may have been selection of O-group fish (mainly $<$10 cm). The problem of comparing the numbers of fish caught by the different ships without knowing their relative fishing powers is apparent. These international surveys were worked by ships of varying sizes and engine-powers, using gears of different types and catching capacities. There was little geographical overlap in the areas fished by the different ships and no duplicate hauls were made for comparative estimates. In an assessment of the distribution of Norway pout in these surveys, therefore, the catches can be used only to indicate centres of scarcity and abundance.

Spring 1960.—During "Ernest Holt's" survey in the central North Sea very few Norway pout were recorded (Figure 5). "Scotia", however, fishing mainly in the area north of 57°00′N, located an area of abundance from approximately 2°W to 2°E and north to 59°45′N.

Autumn 1960.—"Dana", covering the area in the south-eastern North Sea, recorded adult Norway pout in considerable numbers at only two positions (Figure 6) whereas "Scotia", again working in the same area as in the spring, made good catches of fish in the central northern North Sea. Very few O-group fish were caught on these cruises (Figure 7).

Spring 1961.—Results from 3 vessels are available from this survey. "Dana" in the south-eastern area had mainly blank hauls (Figure 8), and the results from "Anton Dohrn" working in the northern area, to the east of the area sampled by "Scotia", showed that the area of high catches of Norway pout taken by "Scotia" did not extend farther to the east.

Autumn 1961.—As in the catch data for the previous autumn it is possible to separate adult and O-group fish by length at this time of the year. "Scotia's" survey did not extend as far to the north as in 1960 but again there is evidence that the area covered yielded higher catches of Norway pout (Figure 9) than the corresponding survey by "Dana" in the south-east. Poor catches of O-group fish were again obtained probably owing to them escaping through the meshes of the trawl (Figure 10).

Fig. 5. Distribution of adult Norway pout. International Herring Survey, Spring 1960.

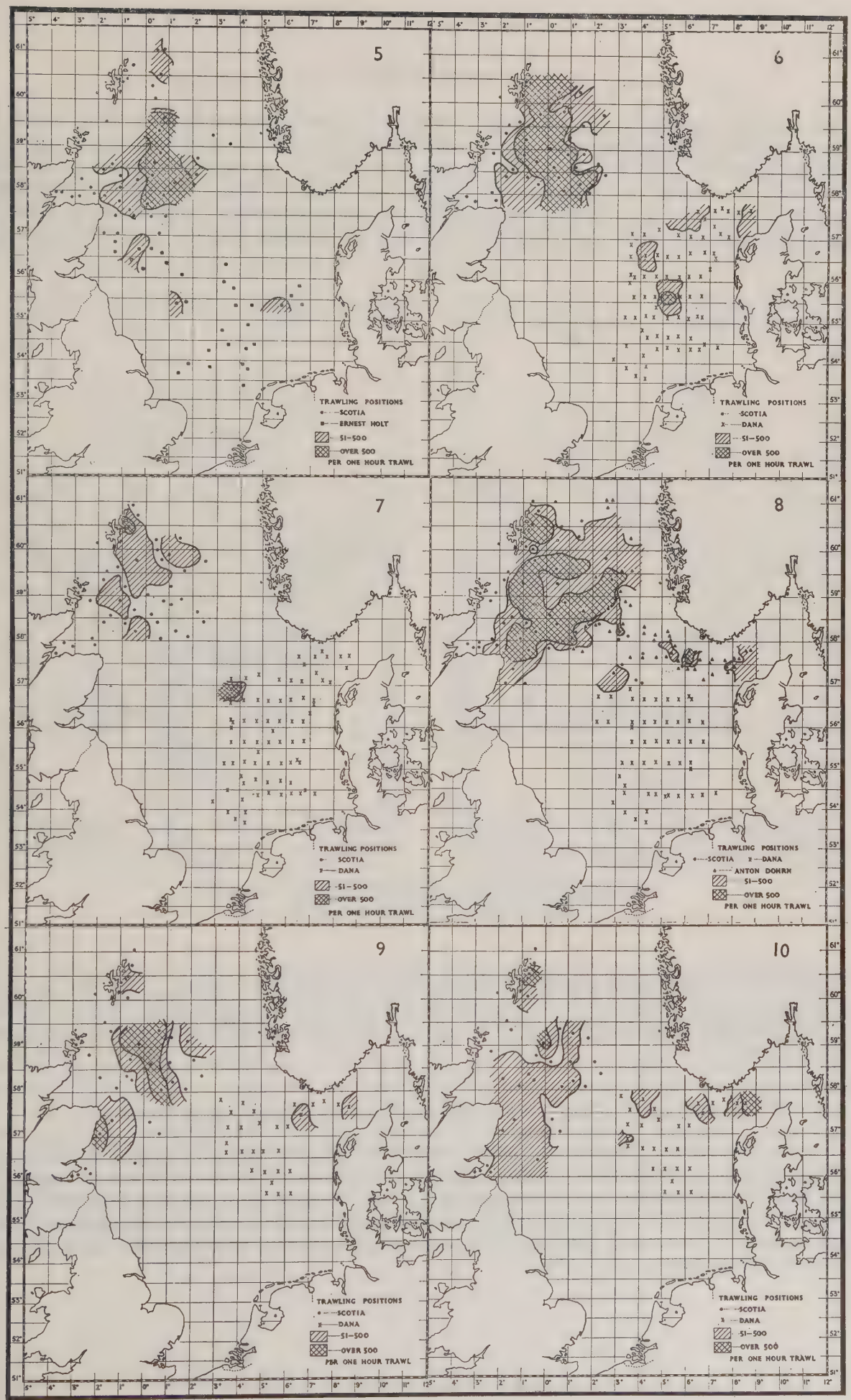
Fig. 6. Distribution of adult Norway pout. International Herring Survey, Autumn 1960.

Fig. 7. Distribution of juvenile Norway pout. International Herring Survey, Autumn 1960.

Fig. 8. Distribution of adult Norway pout. International Herring Survey, Spring 1961.

Fig. 9. Distribution of adult Norway pout. International Herring Survey, Autumn 1961.

Fig. 10. Distribution of juvenile Norway pout. International Herring Survey, Autumn 1961.


5
TRAWLING POSITIONS
SCOTIA
ERNEST HOLT
51–500
OVER 500
PER ONE HOUR TRAWL
6
TRAWLING POSITIONS
SCOTIA
DANA
51–500
OVER 500
PER ONE HOUR TRAWL
7
TRAWLING POSITIONS
SCOTIA
DANA
51–500
OVER 500
PER ONE HOUR TRAWL
8
TRAWLING POSITIONS
SCOTIA
DANA
ANTON DOHRN
51–500
OVER 500
PER ONE HOUR TRAWL
9
TRAWLING POSITIONS
SCOTIA
DANA
51–500
OVER 500
PER ONE HOUR TRAWL
10
TRAWLING POSITIONS
SCOTIA
DANA
51–500
OVER 500
PER ONE HOUR TRAWL

From the four surveys the following results are clear: "Scotia", working in the northern North Sea, recorded consistently high catches of Norway pout in all four cruises and was undoubtedly covering the area of maximum abundance in the North Sea. Surveys by "Ernest Holt" to the south (Spring 1960), and "Anton Dohrn" to the east (Spring 1961), failed to provide any evidence that the area of abundance extended much beyond that sampled by "Scotia". Although higher catches were obtained at the mouth of the Skagerrak, surveys in four cruises by "Dana" showed that Norway pout were relatively scarce in the south-eastern North Sea.

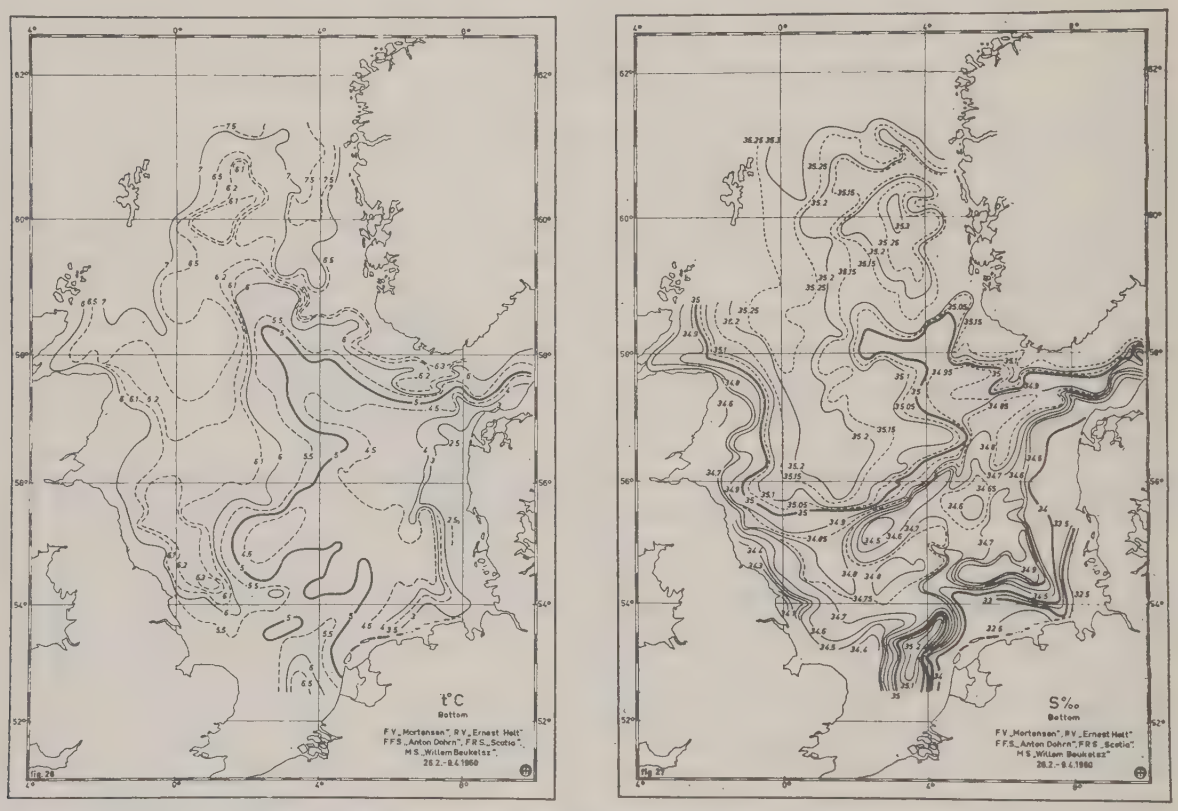


Fig. 11. (a) Bottom temperature during spring survey 1960.
(b) Bottom salinity during spring survey 1960.

The data from these detailed surveys therefore confirm those from the earlier "Explorer" ones in indicating that the main population of Norway pout in the North Sea is distributed to the north of latitude 57°00′N and largely between longitudes 01°00′W and 03°00′E. Only occasional minor concentrations occurred outside this area.

DISTRIBUTION, HYDROGRAPHY AND DEPTH, 1960–61

Schmidt (1909) stated: "In its requirements as regards depth, temperature and salinity the Norway pout comes nearest to the haddock and its spawning regions agree in the main with those of the latter species. There is little spawning in more than 200 or less than 50 metres." He gave the northern and southern limits of spawning as being off north-west and south-east Iceland, and the waters south of Ireland, respectively. He gave as the range of temperature "preferred" by the species for spawning from 6° to 10°C and the minimum "preferred" salinity from 34·50 to 35·00‰.

Most species of fish are capable of survival in environmental conditions considerably outside the limits of their spawning preferences. Data have been published on bottom temperature and salinity in the North Sea during the international herring surveys in spring 1960 and autumn 1960. These are quoted from Gamble *et al.* (1961) (Figure 11 a–d). In Figure 11 c and d, depth contours are included.

A comparison of Figure 11 a and b with Figure 5 shows that in general Norway pout were most abundant during the spring survey in water more than 100 m deep, with temperatures over 6°C and salinity greater than 35.00%. A similar comparison for data in autumn 1960 (Figure 11 c and d, and Figure 6) shows that at this

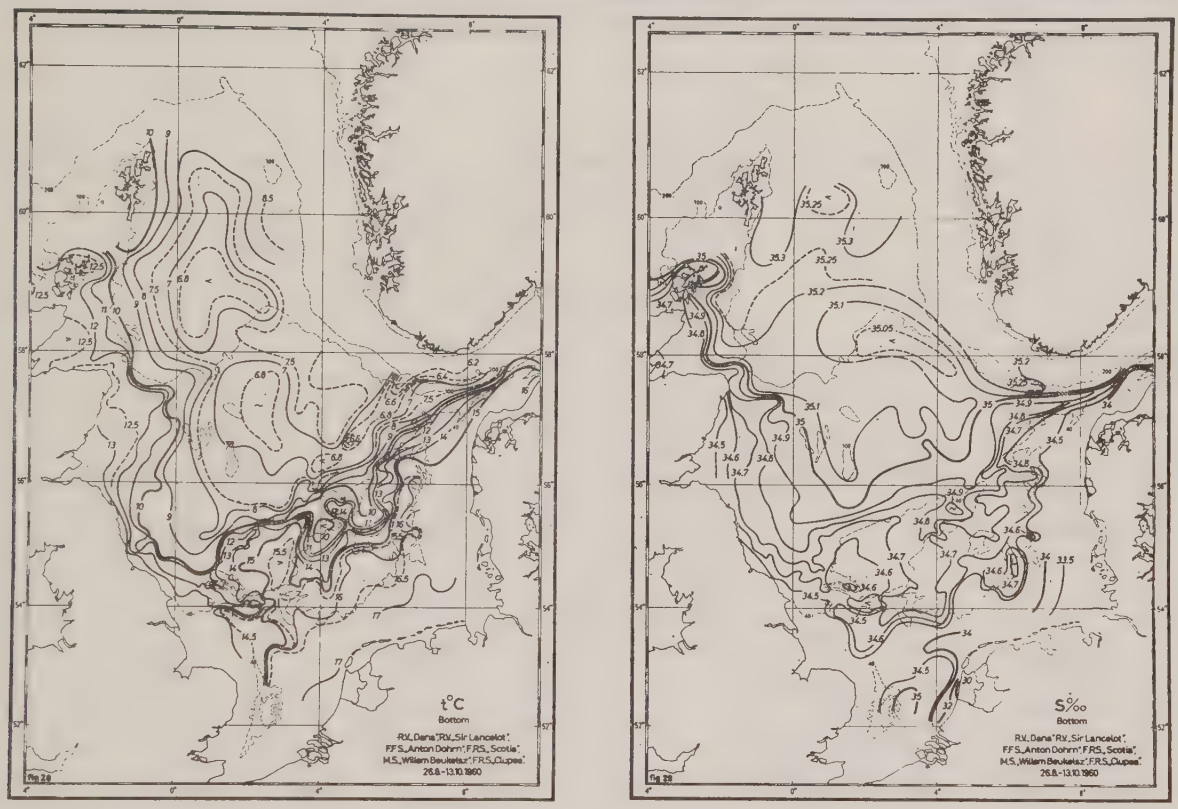


Fig. 11. (c) Bottom temperature during autumn survey 1960.
(d) Bottom salinity during autumn survey 1960.
(From Gamble *et al.* 1961.)

time the fish were most abundant in much the same area of the northern North Sea, in water more than 100 m deep, with a bottom temperature from 7° to 9°C and a salinity greater than 35·00%.

It has already been demonstrated that for the four surveys the region of maximum abundance of adult Norway pout occurred in the area investigated by "Scotia" in the north-western part of the North Sea. The data from "Scotia's" cruises relating the catches of adult fish to bottom temperature and depth have been summarised in Figure 12. In all four cruises catches were highest in water more than 100 m deep and, in the spring samples, with a bottom temperature of 6–8°C. In the autumn samples the temperature relationship was rather different and best catches were made in water with temperatures of 7–9°C but in both years there was evidence that fish were also caught in water with temperatures higher than 11°C.

In presenting the above data it is not intended to suggest that any of the factors described are necessarily limiting. In all instances, however, the relationship between catch and depth seems to be the most consistent, and there appear to be no major changes in the distribution of adult Norway pout associated with the changing temperatures and salinities in the northern North Sea throughout the year.

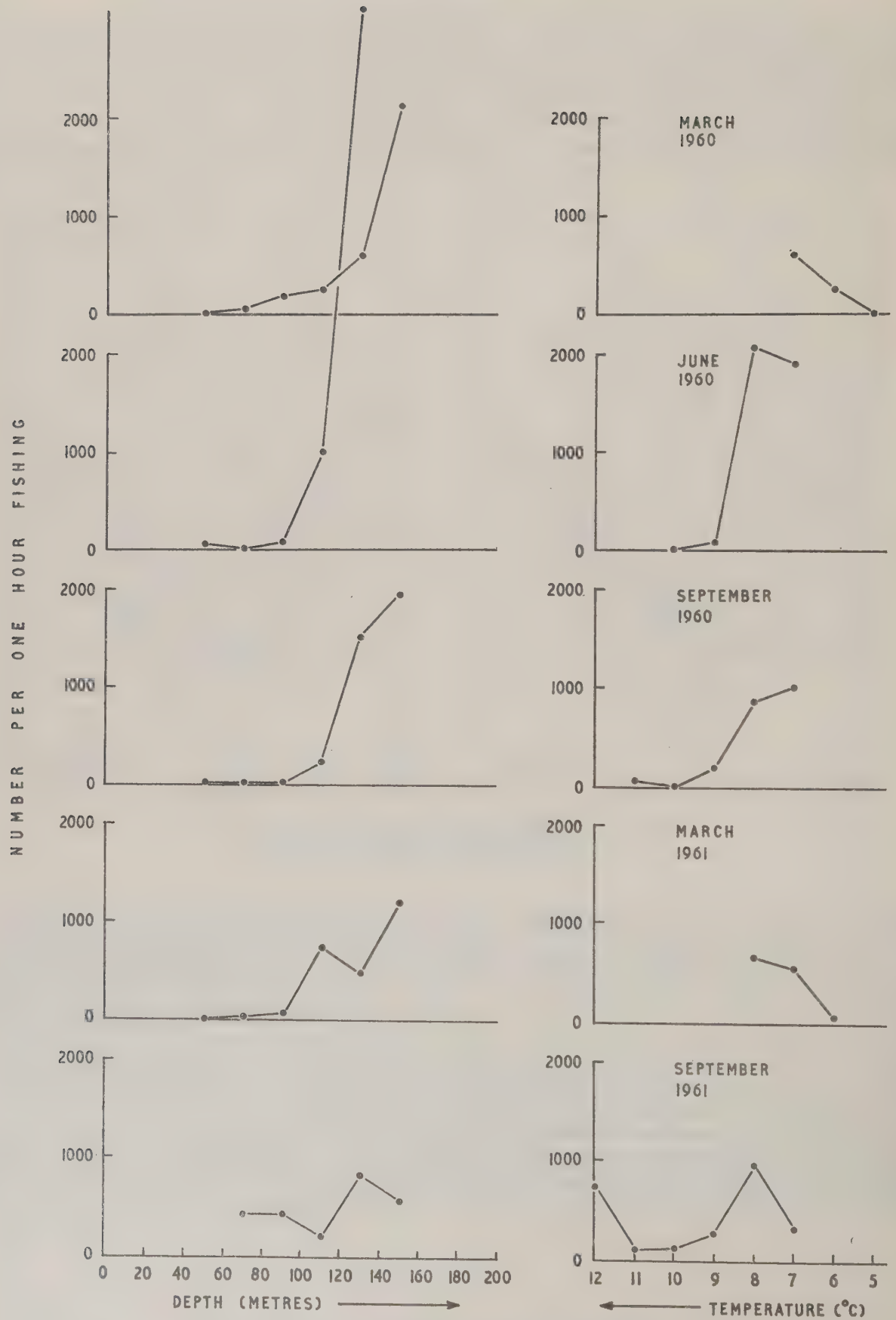


Fig. 12. Catch of Norway pout compared with depth and bottom temperature during "Scotia's" surveys 1960–61.

THE FLADEN SURVEY, AUGUST 1961

During a trawling survey for Norway pout conducted in August 1961 by "Scotia" a concentration of fish was found in the area of the Fladen ground. Trawling on this concentration of fish was carried on by day and night for four days and some of the limits of the distribution were plotted. Figure 13 shows the fishing positions and the catches of adult Norway pout. The area within the boundary lines contains hauls with more than 1,000 adult fish caught per hour's fishing in daylight. The concentration was from 10 to 15 nautical miles wide and at least 35 nautical miles long, but the northern and southern boundaries were not established. It is probable

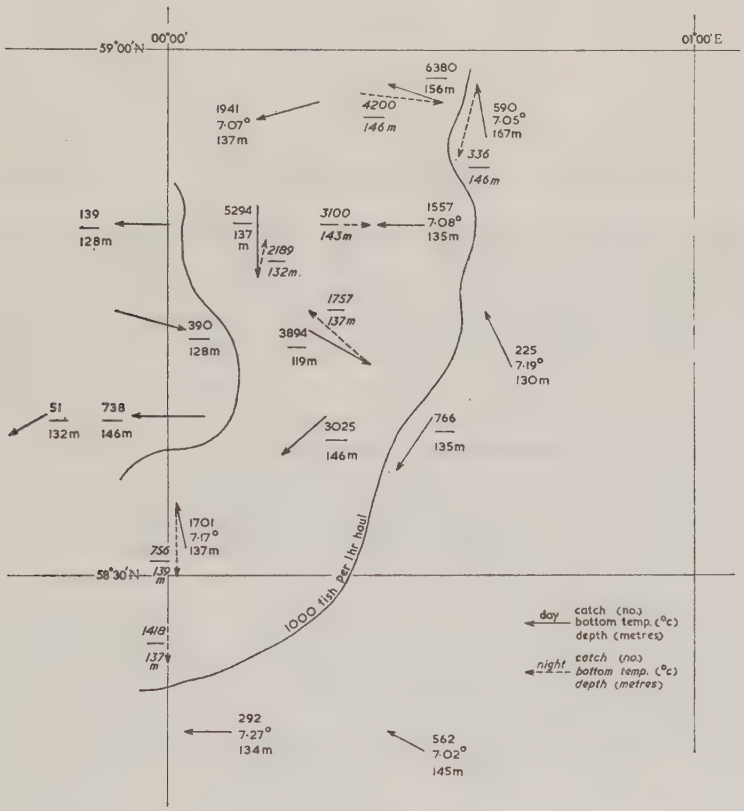


Fig. 13. Distribution of catches of Norway pout on the Fladen ground, August 1961.

that this concentration represents a part of that sampled by "Scotia" in the survey in Autumn 1961 (Figure 9) The western and eastern limits were very well defined, daylight catches falling off from several baskets to less than half a basket as soon as the ship moved outside the area. Figure 13 also shows the bottom temperature and depth at most of the trawling stations. It can be seen that both of these factors were very constant and there are no notable differences in this respect between positions inside and outside the area. The concentration therefore appears to have been independent of these factors.

Although this paper is concerned with occurrence and distribution rather than abundance, it may be appropriate to mention here the observations made during this survey on the diurnal variation in trawl catches of Norway pout. Several of the daylight hauls were repeated in the same position at night (Figure 13) and the catch ratio between day and night hauls is shown in Table I. In only one instance were fewer fish caught during the day. On average the catches in daylight were 1·78 times greater than at night. Analyses of the length-compositions of these hauls showed that there were no significant differences between day and night.

TABLE I

DAY AND NIGHT CATCHES OF ADULT NORWAY POUT, FLADEN GROUND, AUGUST 1961

Day				Night				
Haul No.	Date (Aug. 1961)	Time	Catch	Haul No.	Date (Aug. 1961)	Time	Catch	Ratio of Day : Night
168	18	1440–1540	1701	169	18	2055–2155	756	2·25
172	19	1140–1240	590	175	19	2300–2400	336	1·76
173	19	1405–1505	6380	174	19	2105–2205	4200	1·52
177	20	1120–1220	5294	183	21	2050–2150	2189	2·42
178	20	1335–1435	3894	179	20	2050–2150	1757	2·22
180	21	0835–0935	1557	184	21	2255–2355	3100	0·50
							Mean	1·78

DISCUSSION

Juvenile Norway pout are caught in large numbers in the northern North Sea in the late summer and early autumn and adults are most abundant off the Shetlands and south towards the Fladen and Gut areas (Figure 5). A secondary concentration appears to exist in the Egersund area along the edge of the Norwegian Deeps (Sahrhage, 1964). There is some evidence from past trawling records to suggest a slight northerly migration for spawning to an area between Shetland and Norway and this coincides with the area where the largest concentrations of Norway pout larvae are found in the Spring (Raitt, 1965). Poulsen (1964) has observed that there is a large scale spawning migration from the Skagerrak out into the North Sea and that the larvae and juveniles subsequently drift back into the Skagerrak and Kattegat.

The distribution of Norway pout in the region to the north and west of Scotland is not so clear as the trawling coverage in these areas has not been so extensive. However, from the information available, there are undoubtedly large stocks of Norway pout off the north coast and in the Minches, and although the North Sea and Skagerrak stocks have been exploited by a considerable fishery in recent years by Denmark and Norway (Raitt, 1966) it appears that the area of this fishery has not spread to the west coast so far.

The factors determining the distribution of a fish species are never easy to define since so many parameters may be involved and investigators can never be sure that the correct parameters are being measured. In this present report it seems clear that the distribution of adult Norway pout in the northern North Sea showed no major changes in distribution associated with the changing temperatures and salinities in the years investigated. The most consistent environmental relationship was with depth, highest catches being obtained in water greater than 100 m in depth and less than 200 m. In addition Sahrhage (1964) has observed that the type of substrate prevailing at the bottom may play a part in that these fish are found most often on a muddy bottom. Tambs-Lyche (1954) also found them typical inhabitants of the muddy bottoms occurring in the fjords of western Norway.

SUMMARY

The overall distribution of Norway pout is described and earlier literature is reviewed. The species is confined to the north-east Atlantic area. An analysis of past trawling records of the Marine Laboratory is presented as an average distribution for each month of the year for juveniles and adults. High catches of Norway pout were recorded in the northern North Sea and off the north and west coasts of Scotland. A more recent analysis of records from international herring trawling surveys in the North Sea in 1960–61 confirms the conclusion from previous records that the main population of Norway pout in the North Sea is distributed to the north of latitude 57°00′N and largely between longitudes 01°00′W and 03°00′E. Only occasional minor concentrations occurred outside this area. In all instances the relationship between catch and depth seems to be the most consistent, and there appear to be no major changes in distribution of adult Norway pout associated

with the changing temperatures and salinities in the northern North Sea throughout the year. During an intensive trawling survey of a concentration of Norway pout on the Fladen Ground in August 1961 some of the boundaries of the shoal were determined but these were not associated with depth or temperature. Best catches were obtained by daylight.

The stocks of Norway pout in the North Sea are already exploited by an industrial fishery for fish-meal and there seems no reason why this could not be equally as successful in certain areas off the north and west Scottish coasts but so far trawling records in these areas have not been quite so extensive.

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